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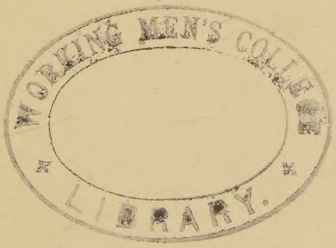
# THE CARE OF THE TEETH



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# THE CARE OF THE TEETH

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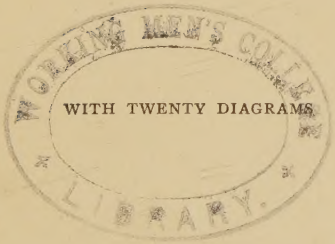


WITH TWENTY DIAGRAMS

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# PREFACE

THE subject of dental disease and its treatment is one that is rather prominently before the public just now. References to it are common in the newspapers, while the serious reviews have not disdained the problem. It would therefore seem a fitting time to group together such facts as are known in a form that can be understood by the public, and with this object the following pages have been written.

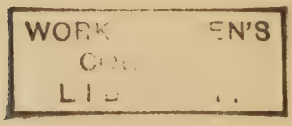
The writer has endeavoured to state the various points of the problem of dental disease and its prevention in clear, non-technical language, and to put his readers in possession of all the facts necessary to show how the disease is caused and how best to prevent it. A certain use of technical terms has been unavoidable, but where used an explanation of their meaning has been given.

The subject is a very large one. Theories abound, and many gaps in our knowledge still exist; but

certain facts are known, and certain theories are generally accepted by the dental profession, and such of them as are necessary to an intelligent co-operation on the part of the community with our profession are here stated.

The real work of the dental surgeon is the *prevention* of dental disease: to accomplish this he must take the public into the fullest confidence, for, to a great extent, it is in the hands of the parents to ensure for their children that most priceless boon, a sound set of teeth.

The writer would like to express his indebtedness to the writings of Dr. Sim Wallace, than whom no one has added more to our knowledge of the subject, and to Mr. J. F. Colyer for the loan of many of the illustrations. A. T. P.



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# THE CARE OF THE TEETH

## CHAPTER I

### THE CARE OF THE TEETH

AT the present time dental caries must be regarded as being the commonest disease from which civilized man suffers. From a very early time decay of the teeth has existed; skulls found in Egypt and dating back at least five thousand years show abundant evidence of its existence, and it would be difficult to examine any large collection of skulls of any race or of any date without finding evidence of dental disease. On the whole primitive peoples are far less prone to dental disease than civilized races, and though it would not be quite right to describe dental disease as a disease of the civilized, yet it is incomparably more common amongst them.

At the present time dental disease is extremely common in this country; the growing recognition of the importance of a healthy mouth and its relationship to national health has done a little, but only a little, to stem the evil. Even so, it is difficult

to find in an adult a set of teeth entirely free from disease.

This increase is not due to any degeneracy of our natural physique; in the majority of cases the teeth when they cut the gum are healthy, and a sound set of teeth is the rule rather than the exception in children of three and four. Neither is it entirely a question of poverty, for children seen at hospitals have often healthier mouths than the children of well-to-do parents. Heredity, though playing a part, is not the main factor, and we must look elsewhere, and, as most of us believe, in the altered habits of life, chiefly in the matter of diet, characteristic of to-day. Now it must not be thought that dental disease, though often causing pain, is not a disease of serious consequence: it is true that only very rarely does it lead directly to serious illness or death, but indirectly it is responsible for an enormous mass of suffering. From the point of view of national health and national efficiency its seriousness can scarcely be overestimated. When we remember that during the South African war over three thousand soldiers were invalided home on account of defective teeth, we realize the serious loss to the nation caused by this disease. And yet all the suffering and all the ill-health resulting from diseased teeth is preventable, and not by any costly or diffi-

cult methods available only for the rich, and not by any drastic change in our mode of living, but by attention to a few simple rules of life, not irksome, but comparatively easy of attainment by almost every person.

It cannot be too widely known that dental disease is a *preventable disease*, and that it is in the power of the community if not to abolish it at least to reduce it to an enormous extent, and with it a very great amount of ill-health. Now in order to be in a position to care effectively for the mouth and teeth, it is necessary, first of all, to know something of the structure of the teeth and the way in which they are formed and come into place in the mouth; then, too, we must know the way in which they are destroyed, and finally from this knowledge we can deduce the best ways of keeping the teeth clean and healthy.

## CHAPTER II

### THE STRUCTURE OF THE TEETH

A TOOTH consists of two parts, a crown and a root. The crown is the part which projects into the mouth and serves to crush the food we eat.

In the front teeth the crown is somewhat chisel-shaped and is used to divide the food into comparatively large pieces, as in eating bread or fruit: the crowns of the back teeth are broad and irregular so that the surfaces are raised into rounded prominences divided from each other by grooves. These teeth are used for grinding the food into small particles.

If we make a longitudinal section through a tooth we see that in the centre is a space running the whole length of the root and extending partly into the crown. This is called the pulp cavity, and during life is filled with a soft jelly-like tissue called the pulp and commonly spoken of as the nerve. It enters the tooth through a tiny opening at the bottom of the root. It consists of a number of nerves and blood-vessels which serve to nourish the tooth and give it its sensitiveness.

Surrounding the pulp cavity on all sides is a hard substance called the dentine or ivory, which forms the greater part of the tooth. When examined under the microscope it is seen to consist of a number of little tubes which open into the pulp cavity and extend outwards. A tiny fibril passes out from the pulp into each tube and in this way keeps the dentine alive.

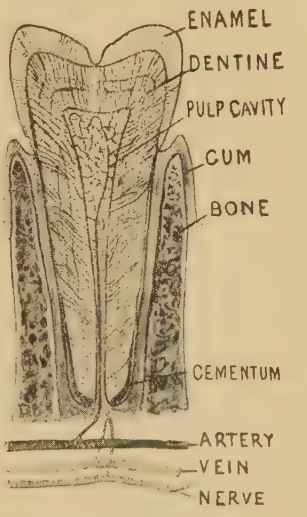



FIG. 1.
A longitudinal section of a tooth.

Outside the dentine we have two substances: the enamel which covers the crown of the tooth, and the cementum which covers the root.

The enamel is the part of the tooth which we see when we look into the mouth; it has a smooth, shiny appearance, and is the hardest substance in the body. When examined under the microscope it is seen to be formed of a number of rods placed side by side.

The cementum is a thin layer of tissue very much like bone in structure, and softer than the dentine.

Now we must consider the way in which the teeth are fixed in the jaws. If we examine a jaw-bone from which the teeth have been removed, we see that it has a number of holes in it; these are the sockets, and during life each socket holds a tooth. The teeth do not fit the sockets tightly as a nail fits the hole into which it is driven, but between the socket and the tooth is a slight space; this space is filled by the periodontal membrane, and it is by means of this membrane that the tooth is held in its place, for it consists chiefly of fibres which are fixed into the cementum of the tooth and the bone of the socket. The tooth is thus slung in its socket and can be moved slightly in all directions. The result of this is that when the tooth is bitten upon it yields a little and, like a railway buffer, lessens the shock of mastication. At the neck of the tooth the periodontal membrane blends with the gum, and it will be seen from the diagram that the gum is raised a little above this junction so that there is a small space or ditch round the neck of each tooth.

FIG. 2.

A longitudinal section through a tooth magnified to show the tubular structure of the dentine or ivory.

In addition to its fibres the periodontal membrane also contains many nerves and blood-vessels which tend to nourish both the cementum and the bone of the socket.

## The Composition of the Teeth

The enamel and dentine are made up of hard and soft elements. As we shall see presently, the teeth when first formed are entirely soft; they become hard later because lime salts are deposited in them. This deposition of lime salts goes on to a greater extent in the enamel than the dentine, so that the former is much the harder tissue.

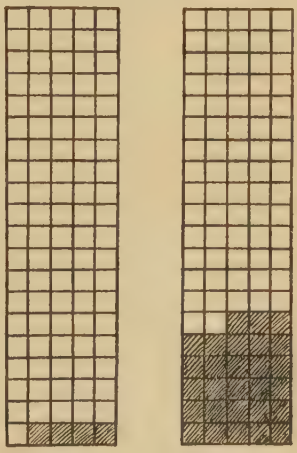



FIG. 3.

A diagram to show the hard and soft elements of which the enamel and dentine is formed. The shaded bricks represent the hard elements.

If we were to imagine the tooth as being built up of hard and soft bricks, we could say that the enamel is formed of ninety-seven hard bricks with only three soft bricks, whereas the dentine has seventy-two hard bricks to twenty-eight soft bricks.

The importance of the enamel as a protective covering to the crown of the tooth is very great, and when it is destroyed by decay, the dentine being so much softer offers less resistance, and decay then spreads very rapidly.

Now we must consider how the teeth grow.

The body is made up of different tissues and organs, very diverse so far as their shape, structure, and function are concerned, but all having one thing in common—that they consist of cells, so that a cell must be regarded as the unit of life. In the beginning these cells were all alike ; the life of every individual starts as a single cell which goes on dividing until it forms a cluster of cells still alike ; then these cells begin to vary in shape and to form different layers, from which the different tissues of the body are formed.

Some go to form bone, others nerves, muscles, skin, hair, etc. When this differentiation has gone on, the cells become greatly modified, so that the cells forming muscle, for example, differ very much from those forming glands such as the liver or spleen, but in the beginning the cells are alike ; such a cell consists of a little round mass of a spongy substance called protoplasm bounded by a delicate membrane. When treated by suitable stains, one part of the protoplasm appears as a dark spot called the nucleus ; this

consists of protoplasm which is more highly specialized than that forming the rest of the cell, and on the existence of this nucleus depends the power of the cell to go on living and dividing into other cells.

Now the teeth are formed from cells in the same way as the rest of the body. Long before the birth

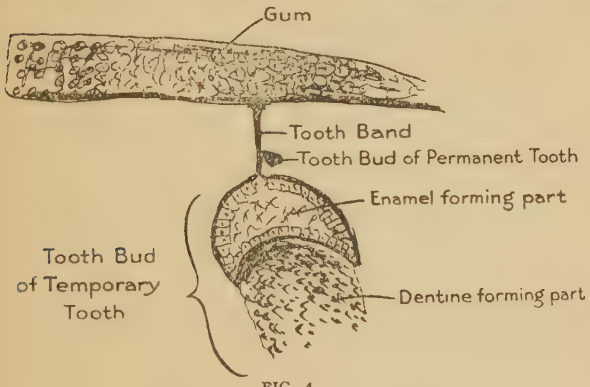



FIG. 4.

Diagram to show the development of a tooth.

of a child the layer of cells which line the inside of the mouth and are called epithelial cells, begin to multiply and grow downwards into the cells beneath, which are of a different type. This growth goes on all round the upper and lower jaw, and ultimately forms a narrow band of cells called the ' tooth-band.'

The next thing that happens is that at certain points which correspond to where the teeth will

eventually cut the gum, little buds of cells grow out from the side of the tooth-band; these are the enamel organs. These enamel organs then go on growing and assume a shape like that of a bell, the handle representing the cells connecting the germ to the tooth-band, while the bell itself is the tooth-germ.

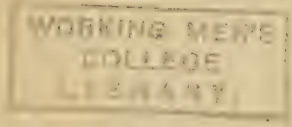
As the tooth-band and tooth-germ are embedded in cells equally soft, though differing in shape, it follows that the inside of the bell is filled up with cells; these cells then go on multiplying and form a dense mass which is called the dentine germ. The whole mass is now called a tooth-germ, and from it all the different parts of the tooth are formed. The enamel organ forms the enamel, the dentine germ forms the dentine and cementum, and then much diminished in size persists as the nerve of the tooth.

The tooth-germ is, of course, at first a soft jelly-like structure, but soon the lime salts which are present in the blood in solution pass into the cells of the tooth-germ and are deposited in them as granules which become hard. The process may be compared to the way in which a piece of linen becomes stiff when dipped in starch.

More granules are deposited in the enamel than in dentine, so that the former tissue is the harder and stronger. Such then in brief outline is the way teeth are formed.

It is important to remember that this process occurs at different times with the different teeth, so that there is a continuous process of tooth formation commencing before birth and going on after birth until the child is about fifteen or sixteen years of age. During all this time any illness or lack of proper feeding may be reflected in the teeth and cause them to be badly formed. As Kipling puts it, 'the fathers have eaten sour grapes and the children's teeth are liable to be affected.'

Man in common with most animals possess two sets of teeth—the temporary or milk teeth, which only last for a few years, and the permanent teeth, which last, or ought to last, for the whole period of adult life. In the next chapter we shall describe the temporary or milk teeth.



## CHAPTER III

### THE TEMPORARY TEETH

THE temporary or milk teeth are ten in number in each jaw; these teeth are given certain names. The two front ones are the central incisors; the next to these and resembling them in shape are the lateral incisors; then come the canine or eye teeth, and those behind the canine are the first and second molars.

These teeth are well seen in the accompanying illustration. The teeth in the lower jaw resemble generally those of the upper jaw, but are smaller. It will be seen that the teeth are so arranged in each jaw that they form a broad arch; again, the lower arch is smaller than the upper arch, so that the lower teeth meet inside the upper teeth. When the teeth are closed, they meet closely so that the food is ground up small between the upper and lower molars.

The germs of the temporary teeth commence to become hard or calcify some time before birth, and at the time of birth calcification has well advanced but is still far from complete.

The teeth commence to cut the gum at about the age of six to nine months. The first to appear are usually the lower central incisors, which are followed rapidly by the lateral incisors; the process of

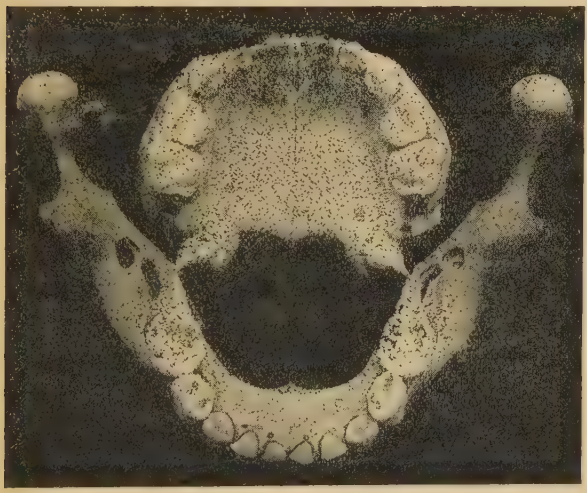


FIG. 5.

Upper and lower jaw showing a complete set of temporary teeth.

eruption is rapid, or completed in about a fortnight. Then comes a rest of two or three months and the upper incisors commence to come through, and by about the age of eleven months all eight incisors are in position.

The next teeth to come through are the first

molars, which appear about the twelfth to fourteenth month. Then appear the canines, from the fourteenth to twentieth month, and finally the second molars, from the twentieth to the thirtieth month.

It will be apparent that these dates are quite approximate, for the temporary teeth show great variation in their time of eruption, so that there is no need for alarm if a baby is backward in cutting its teeth. By the age of three years, however, a child should have its full set of temporary teeth. There is a disease which causes delay in cutting the teeth, and that is rickets. It is due to improper feeding, especially feeding the baby on patent foods, so that if a child is very late in cutting its teeth and does not appear to be thriving properly, it should have medical attention. I have just said that a child should have its full set of teeth by three years, but this does not mean that the teeth are completely formed.

When a tooth commences to erupt only the crown and a part of the root is formed, and the root goes on growing after eruption and is not finally completed until about two years later

Then a word must be said about the condition of the child during teething. The gums are often tense and swollen over the eruptive tooth; there is marked dribbling and a tendency for the child

to bite at any object it can seize. It is irritable and restless, and there may be a little feverishness.

FIG. 6.

Upper and lower jaw of a child of four years with all the temporary teeth present. The first permanent molar in the lower jaw has nearly the whole of its crown formed.

The disturbance is greater with the eruption of the molar teeth than with the incisors.

The amount of disturbance during teething varies very much with different babies, but with a healthy

breast-fed child it is rare for the teething to cause any serious trouble ; if it does it is because the child is already sickly. In any case the ' teething powders ' which are so extensively advertised should be shunned like the plague, for they often contain powerful drugs which may seriously affect the child's health.

It is a good thing to let the child have something hard to bite, for the instinct to do so is a natural one and gives relief.

The old-fashioned coral, provided it be kept scrupulously clean, is good ; or else a piece of hard crust.

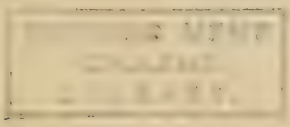
From the age of three up to about six years no more teeth come through, but during this time two changes occur in the temporary teeth which must be mentioned. The first is that the temporary teeth, especially the front ones, become ' spaced,' that is to say, that the jaws increase in size and the teeth become separated from each other.

In some cases this does not occur, and it generally means that the permanent teeth when they come through will be crowded.

The other change is that the temporary teeth become very much worn down by mastication. This change is a sign that the child is chewing its food properly and that the teeth are not tender

through decay. If any proof were needed of the fact that thorough mastication of its food is as necessary to a child as to an adult, and that the temporary teeth can work quite as hard as the permanent teeth, it may be found in the wearing down of the temporary teeth.

A sufficiency of hard food which needs plenty of chewing helps the jaws to grow properly, the teeth to be kept clean easily, and greatly lessens the liability to decay.



## CHAPTER IV

### THE PERMANENT TEETH

THE first tooth of the permanent set to make its appearance is the *first permanent molar*. It comes through about the age of six, but it may erupt as early as five and a half years or as late as six and a half.

It does not come up underneath a temporary tooth and displace it, but appears *behind the second temporary molar*, so that by the age of eleven years a child should have twelve teeth in each jaw: there are three molar or grinding teeth present on each side; the two front ones are the temporary molars described in the previous chapter; the last molar, much larger and stronger than the others, is the first permanent molar tooth. I have emphasized this because it is far from being generally recognized, and this ignorance on the part of parents as to the nature of the tooth often means the beginning of much suffering to the children.

Every dental surgeon with experience of hospital practice must have seen innumerable cases of

children of seven or eight years where the first permanent molars have been so extensively diseased

FIG. 7.

Upper and lower jaws of a child of six years. The temporary teeth are all present. The first permanent molars have commenced to erupt. The permanent teeth which succeed the temporary teeth are being formed underneath the latter.

that extraction of them has been inevitable. Many times I have pointed out to the parents how serious it was that a tooth which Nature intended to last for forty years should only have lasted two years,

and I have been informed that ' it can't be a second tooth, because the child has not lost any of its first teeth.' I have even found it difficult sometimes to

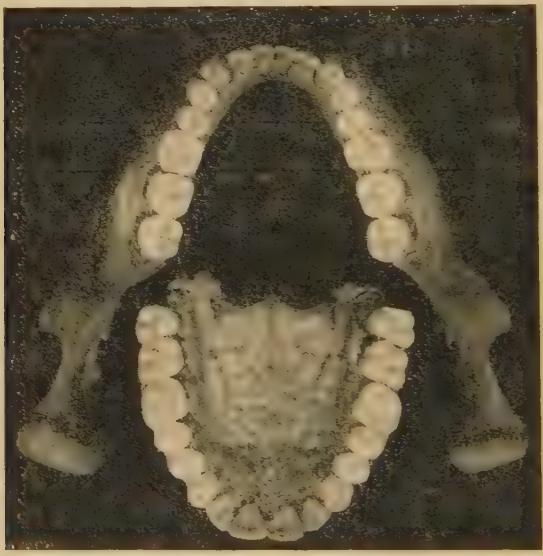


FIG. 8.

Upper and lower jaws of an adult showing a complete and perfect set of permanent teeth.

convince the parents that I was right and they were wrong.

It is easy to see how this mistake arises ; of the thirty-two permanent teeth, twenty of them displace the twenty temporary teeth. When this occurs

the child will certainly let its parents know; so thrilling an event does not pass unnoticed, as readers of Mark Twain's classic *Tom Sawyer* will remember; and then the gap in the mouth and the

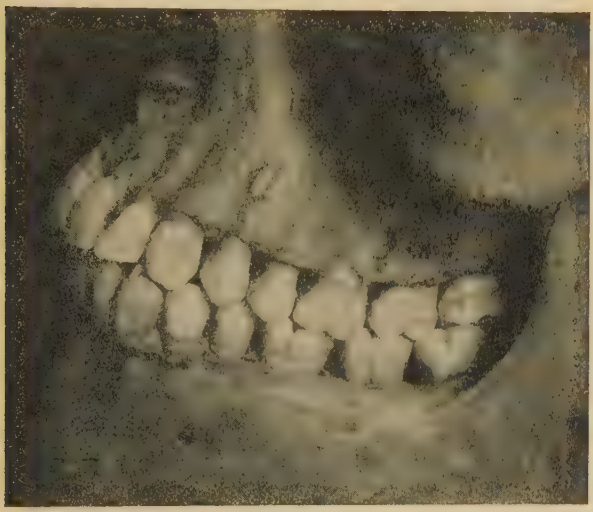


FIG. 9.

Upper and lower jaws of an adult showing the way in which the teeth meet when the jaws are closed.

gradual growth of the permanent tooth in its place all combine to impress both parent and child. Thus has arisen the idea that a permanent tooth can only erupt by displacing a temporary tooth. But the first permanent molar erupting quietly and painlessly behind the second temporary molar

is an event which passes unnoticed by parent and child, and therefore decay can easily spread from the temporary to the permanent molar, and even if the parents notice it they console themselves with the idea that ' it is only a baby tooth and doesn't matter.'

I have started this chapter by describing the erupting of the first permanent molar because of its great importance. Now let us retrace our steps and discuss the permanent teeth in due sequence.

Fig. 8 shows an upper and lower jaw with perfect permanent teeth.

In each jaw sixteen teeth are present; beginning at the front they are named as follows :—

UPPER JAW

| Permanent Teeth. | Temporary Teeth. | Date of Eruption. |
|---|---|---|
| Central incisor | displaces central incisor | 7 years 6 months |
| Lateral incisor | ,, lateral incisor | 8 years 9 months |
| Canine or eye tooth | ,, canine or eye tooth | 11 years 9 months |
| First premolar | ,, 1st temporary molar | 10 years |
| Second premolar | ,, 2nd ,, ,, | 11 years |
| First permanent molar | appears *behind* 2nd temporary molar | 6 years 3 months |
| Second ,, ,, | ,, *behind* 1st permanent molar | 12 years |
| Third ,, ,, | (wisdom tooth) appears *behind* 2nd permanent molar | 16 to 20 years |

## Lower Jaw

| Permanent Teeth. | Temporary Teeth. | Date of Eruption. |
|---|---|---|
| Central incisor | displaces central incisor | 6 years 6 months |
| Lateral ,, | ,, lateral ,, | 7 years 6 months |
| Canine ,, | ,, canine ,, | 10 years 6 months |
| First premolar | ,, 1st temporary molar | 10 years 6 months |
| Second ,, | ,, 2nd ,, ,, | 12 years |
| First permanent molar | appears *behind* 2nd temporary molar | 6 years |
| Second ,, ,, | ,, *behind* 1st permanent molar | 12 years |
| Third ,, ,, | (wisdom tooth) appears *behind* 2nd permanent molar | 18 to 25 years |

It will be noticed that the permanent teeth of the upper and lower jaw are arranged in even arches, which are both broader and larger than the arches of the temporary teeth.

Moreover, the teeth are so placed that each tooth is in contact with its neighbour; this is important, for it helps to prevent food from being forced down between the teeth.

The upper arch is broader than the lower arch, so that when the jaws are closed the upper teeth bite outside the lower teeth. The way in which the teeth meet is also worthy of note. They do not meet edge to edge but interlock something like the

cogs of two wheels, so that practically every tooth meets two other teeth in the corresponding jaw. In this way the teeth are closely adapted to each other, and the maximum amount of grinding power is got out of the teeth. It follows, too, that whenever a tooth is lost, not only the corresponding tooth but part of another tooth becomes functionless as well.

With the exceptions of the second and third molars, the germs of the permanent teeth are formed before birth; the germ of the first molar commences to calcify just before birth, the others do not calcify until after birth, and the process is not finished until about the age of sixteen years or even later. The crowns, however, are all completed by about ten years; any illness or malnutrition occurring during that time may be reflected in the teeth in the shape of defective structure; such diseases as rickets, measles, scarlet fever, whooping cough, etc., may all damage the teeth. Such teeth are often called 'honeycombed' teeth because of their pitted appearance, and they are far from uncommon. The front teeth being formed during the first four years when the child is liable to these maladies are especially affected; not only are they unsightly, but by reason of their poor quality are very liable to decay early.

The process by which the permanent teeth succeed the temporary teeth is as follows.

As the permanent tooth grows it pushes its way nearer to the surface of the gum and comes into contact with the root of the temporary tooth. In consequence of this pressure a little mass of cells forms which has the power of eating away the root of the temporary tooth. In this way room is made for the permanent tooth to grow longer without appearing to interfere with the temporary tooth. The process of absorption of the latter goes on until all the root is removed and only the crown left; this is only attached to the gum and soon becomes loose, and is then painlessly detached from the gum. The top of the permanent tooth is then visible and erupts in just the same way as did the temporary tooth. At this stage only the crown and a part of the root of the permanent tooth is formed, and when first erupted its attachment to the jaw is weak, but as the root goes on being formed the bone around it becomes thicker and the attachment firmer.

There is one condition in which the proper absorption of a temporary tooth may be hindered, and that is when the latter is decayed and an abscess has formed under it. The presence of the poisonous matter or pus seems to prevent the absorption of the root of the tooth, and so it may be retained for

an unusually long time. It sometimes happens that if the temporary tooth has decayed so far that only the roots are left, that the permanent tooth instead of absorbing the root will push its way past it and so erupt into a wrong position ; this is quite a common cause of irregularities of the permanent teeth.

## CHAPTER V

### THE CAUSES OF THE DECAY OF THE TEETH

ALTHOUGH as I have noted in the first chapter, decayed teeth have been found in the skulls of very ancient races, yet it has become much commoner in modern times. As civilization has advanced, so, too, has dental disease advanced, yet we must not regard the latter as one of the inevitable penalties which we pay for the high standard of civilization, for the connection between the two is one that could be prevented.

The actual cause of dental caries is to be found in the changes undergone by certain of the food-stuffs in the mouth. There are three great classes of foods which make up our dietary: these are, first, the meats, such as beef, mutton, poultry, and fish. Then we have the fats which we usually take together with the meat, but which chemically are different; and lastly there are the carbohydrates which include starch and sugar, and form a very large and important part of our diet. It is this latter class of carbohydrates which are concerned with the causation of dental caries.

It is well known that if milk be exposed to the air for long it becomes sour owing to the formation of an acid in it called lactic acid. This change can be prevented if the milk be enclosed in a sealed vessel to which the air has no access; under these conditions the milk will remain sweet indefinitely. This souring or fermentation of the milk is due to the action of minute organisms which are always present in the air; these organisms act on the sugar in the milk and turn it into lactic acid. Now, not only the sugar in the milk but nearly all classes of carbohydrates under suitable conditions are capable of undergoing fermentation, with the result that lactic acid is formed. In every mouth, even the healthiest, there are normally present many millions of microbes, and a great number of these microbes possess the power of acting upon the carbohydrate food and converting it into lactic acid. So far as the bulk of our carbohydrate food is concerned, this change does not occur; the food is masticated and mixed with the saliva and swallowed, but a small residue clings to the teeth, and when this occurs the microbes in the mouth can convert it into lactic acid.

The essential cause of dental caries is therefore due to the fermentation of carbohydrate food *in contact with the teeth* into lactic acid by means of the action of microbes in the mouth.

I particularly wish to emphasize the fact that this change only occurs in the food which sticks to the tooth, for in considering the means of preventing dental caries, this is the vital point. We cannot dispense with carbohydrates, neither can we rid the mouth of microbes, so that we are left with the problem of how to prevent food from lodging around the teeth. When the lactic acid is formed it then begins to act on the teeth. In describing the structure of the teeth, I mentioned that the hard tissues of the teeth, namely, the enamel and dentine, owe their hardness to the fact that they are impregnated with lime salts. Now lime salts are soluble in acid, so when the lactic acid is formed it first begins to act on the enamel and dissolves the lime salts. The enamel is very hard and consists almost entirely of lime salts (97 hard bricks to 3 soft bricks), so that the lactic acid entirely destroys it. The dentine which lies under the enamel is now exposed, and is attacked in the same way until the lime salts are all dissolved. But the dentine is softer than the enamel and contains less lime salts (72 hard bricks to 28 soft bricks), so that when the lime salts have been dissolved there is still some of the dentine left, but instead of being hard it is quite soft, like gristle.

Now we come to a fresh stage in the process: there are microbes in the mouth which are able

to attack the softened dentine and digest it just as the gastric juice in the stomach is able to digest

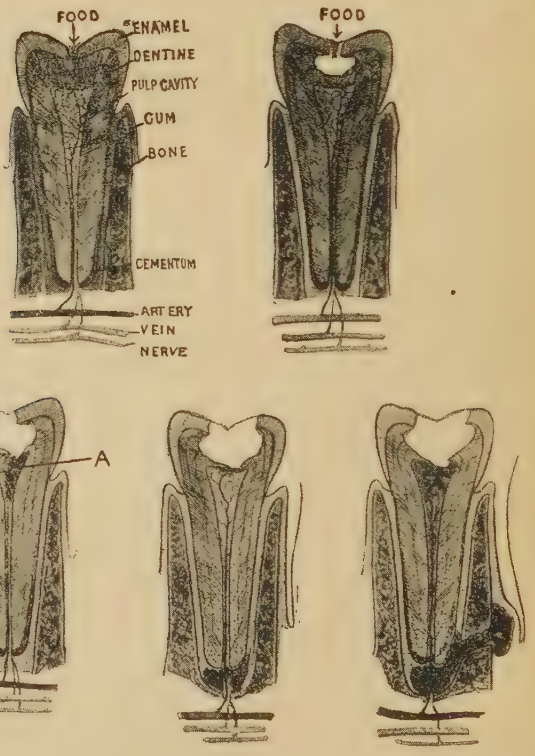



FIG. 10.

Diagram showing the stages of destruction of a tooth by dental decay.

meat. It will be remembered that the dentine is formed of a great number of fine tubes, and these

microbes pass down these tubes and eat their way into the soft dentine.

The result of all this is that a cavity is formed in the tooth; very often the opening of the cavity is

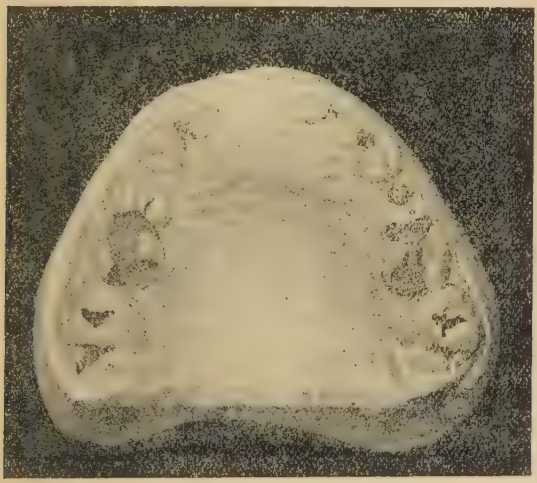


FIG. 11.

Model of an upper jaw of a child of eight years showing extensive decay of the temporary molars and commencing decay of the first permanent molars.

quite small, although inside it the decay has spread under the enamel until a large part of the tooth has been destroyed. If, as often happens, the cavity is between two teeth and concealed from view, a person may not be aware that there is anything wrong until the unsupported enamel suddenly gives way

and leaves a large hole, although the mischief may have been going on for months.

As the cavity enlarges it gets nearer to the nerve, and attacks of pain may follow, especially at meal-times, partly because hot and cold things affect the nerve, and partly because food becomes jammed into the hole and presses on the nerve; the latter becomes inflamed in consequence, and the pain may be very severe although in some cases it may be entirely absent.

The next stage is that the inflamed nerve dies, and as a result pain for a time ceases.

This must not be taken to mean that the mischief has stopped, for, on the contrary, it still goes on. Although the nerve is dead and can no longer give rise to pain, yet like all other dead tissue it goes bad or putrefies. This change is caused by the action of certain germs always present in the mouth. As these germs pass along the dead nerve they come finally to the end of the root, where they meet the soft membrane lying between the tooth and its socket and set up inflammation in it. The patient soon begins to get pain again, for every time the tooth is bitten on this inflamed membrane is jarred.

Lastly, an abscess begins to form at the end of the root. Now an abscess contains a fluid called pus, and this, like all fluids, pushes its way in the direction

of least resistance, which happens in most cases to be through the gum covering the root and in contact with the cheek; when this happens the abscess bursts and forms what is known popularly as a gum-boil, which may go on for years and, like a volcano, periodically burst into activity. Sometimes the abscess instead of bursting attains a large size, causing much disfigurement and giving rise to great pain, and may even end in serious illness.

Of course, not every decayed tooth goes through all these stages, but very many of them do, although the various stages may spread themselves over a long period.

Now we must consider why it is that dental caries is so much commoner to-day than it used to be. The food habits of different races at different times have been extensively investigated, and we are able to say fairly definitely why it is that dental disease is so common to-day.

First of all, we find that although no races are immune from dental disease, yet decay is relatively much rarer among meat eaters than among those who live chiefly on starchy foods. For instance, the Eskimos live chiefly on meat and fat, and among them decay is rare; the Gauchos of South America are said to live almost entirely on meat, and again decay is rare among them.

Among the uncivilized races which are mixed feeders, eating starchy foods as well as flesh, we find the incidence of dental caries is higher, and yet low as compared with civilized races. This is to be explained by the fact that much of their food is taken in an uncooked form largely in the form of fruit and roots. Such food is coarse and gritty and fibrous, it needs a considerable amount of chewing, and this prevents the food clinging to the teeth, for efficient mastication is Nature's method of cleaning the teeth. A good example of this is seen among the Kaffirs, who live chiefly on maize, which is a starch, and yet they have excellent teeth. The maize is ground up into coarse particles and all the natural fibrous elements in it are retained; moreover, fragments of earth and stone are often present in it, so that although their food is chemically capable of being fermented into lactic acid, yet actually it is not so changed, because it is not sticky and does not cling to the teeth. Another factor of importance is that when uncooked fruit is eaten its acidity causes a marked flow of saliva, which tends to wash away any fragments of food which otherwise might undergo fermentation.

The Chinese live almost entirely on rice which is under-boiled; this mode of preparation is important, for whereas rice as used among us is well cooked and

in consequence sticky, as prepared by the Chinese it eats crisply and does not cling to the teeth. According to the testimony of competent observers the Chinese have excellent teeth, and this despite the fact that their food contains a large amount of fermentable starch.

Coming now to civilized races, of which we may take our own country as an example, we find the food habits of the people have undergone many changes. If we go back to very ancient times to the Danish and Saxon periods we find from the examination of the skulls found in barrows, or the sites of old battlefields, that decay was rare although present. So far as we can tell, the food was mixed in character, but a considerable amount of it was eaten either uncooked or slightly cooked. Such food must have needed much chewing, for we find that the teeth of young adults are worn down to a smooth polished surface. The *sticky* element was absent from their food, and to this they owed their comparative freedom from decay.

Coming now to a period distinctly civilized, e.g. the Tudor or Stuart period, judging from the examination of skulls, decay though commoner than in the Saxon times, yet was far less common than it is to-day. Superficially the food habits of these days would not seem to be very different from those of

to-day, yet in reality there are marked differences. First of all, so far as meat is concerned, more meat was probably eaten in the Elizabethan era than to-day; the meat then was simply cooked, either boiled or roasted, methods which do not eliminate the qualities of toughness and therefore compel mastication. To-day much of our meat is taken in a made-up form, as a glance at the menus of our restaurants reveals, and can be eaten with the minimum of chewing and the minimum of time.

Of the starchy elements, we find that bread then and to-day is the chief form in which starch is taken, but there is a vast difference in the bread as eaten to-day and that of two hundred years ago. The flour was ground by mill-stones and the whole of the wheat was utilized, so that the flour was wholemeal flour. It was comparatively coarse in texture, and the bread made from it was very different from our modern bread. To begin with, it was not white; it ate crisply, and needed a considerable amount of chewing. Again, much of the bread was home-made; instead of getting new bread every day the housewife of those days made her bread in a batch which lasted for a week or more, so that much of the bread was eaten stale. Now such bread even when new, and still more when stale, when chewed did not form a sticky mass, so that there was

comparatively little débris to cling around the teeth.

Now to-day practically all the flour used is made by machine and crushed by steel rollers, so that it is very much finer in texture. Then again, public taste insists on a white loaf, so that the husk and germ of the wheat which represent the fibrous element of the wheat are eliminated, while the flour is subjected to a bleaching process to make it as white as possible. Moreover, in the towns and even in the country, bread is rarely made at home, and so being easily procurable at all times is eaten much newer. Now as a result of all this we find that the bread of to-day when chewed forms a sticky mass which binds together and clings readily to the teeth, and the newer it is the more it clings. It is probable, too, judging from experiments, that steel-ground flour is actually more fermentable in itself than stone-ground flour, so that if two equal amounts of bread made from stone-ground and steel-ground flour were submitted to the same conditions in the mouth, the latter bread would form a greater amount of lactic acid in a shorter space of time than the former bread.

Contrasting the bread made of whole-meal stone-ground flour with the modern loaf of fine steel-ground white flour we may say that, firstly, the modern loaf

contains far less of the fibrous element of the wheat than the whole-meal loaf; secondly, when chewed it is formed into a sticky mass which tends to cling to the teeth; thirdly, it is eaten in a newer condition than the home-made whole-meal loaf, so that the tendency to stick to the teeth is increased; and fourthly, owing to the various processes to which modern flour is subjected chemically, it is more readily fermentable into lactic acid than stone-ground flour. For these reasons, modern bread, in part at least, must be held responsible for the increase of dental caries.

Now let us consider another article of diet, namely, sugar. To-day the consumption of sugar, derived either from the sugar-cane or from beetroot, is about seventy pounds per head per annum. The consumption of sugar has increased enormously in modern times, and in a score of ways unknown to our forefathers it forms a part of our modern diet. Of course sugar in the form of fruit and honey, or as contained in bread and pastry, must have formed a considerable part of the diet of older days, but sugar as an element of food was uncommon; even in the eighteenth century, when a considerable amount of sugar was grown in the West Indies, it was still a luxury in this country. We may say that to-day sugar is taken in four main forms: first, in the form

of sweets; secondly, in the form of jam and preserves; thirdly, as an addition to tea, coffee, and cocoa, and fourthly, as a chief ingredient in the sweet dishes which are commonly served at the end of dinner and lunch.

In the eighteenth century amongst the mass of the people we find that these four food habits were, comparatively speaking, absent or infrequent. Tea and coffee were expensive luxuries, and so little sugar was consumed in this way. Sweets were rare, and the sweetstuff-shop rarer still; no doubt home-made sweets were eaten but as a luxury, while to-day the modern child would seem to regard them as a necessity. Jam was a less common article of diet; the home-made preserves contained less sugar than the modern shop-bought article, and far less of it was used, while the sweet dishes of our modern dinner-table were far less conspicuous two hundred years ago. It is therefore easy to see why the consumption of sugar has increased, especially as the production of sugar from beet has cheapened the price so that it is now brought within reach of the poorest classes.

Now in estimating the rôle that sugar plays in the causation of caries, several factors must be recognized.

Firstly, from the chemical point of view, sugar is readily fermentable into lactic acid; on the other

hand it is very soluble, and for this reason it used to be thought that sugar as an article of diet did not play any important part in causing dental caries. So far as the sugar taken in tea and coffee is concerned this is probably true, but it must be remembered that along with the afternoon cup of tea (an essentially modern development) biscuits or cakes are usually eaten, and these are sticky foods. So that the increase in tea-drinking, though it may not play any part in causing dental caries so far as the sugar used to sweeten the tea, yet in virtue of the food used, such as biscuits, etc., taken with it, it does play a part.

With regard to sweets, jams and confectionery, the sugar in itself must be regarded as a potential cause. When sweets are eaten (by which I mean confectionery) they are not taken at the close of a meal but at odd times. They are essentially a luxury, and the tendency is to eat them at odd times, especially at the close of a day. The child is often bribed to go to bed with a sweet which it takes with it, or the dose of medicine is followed by a piece of chocolate. Now it is a commonplace that while a piece of loaf sugar quickly dissolves, sweets as a class last longer, and many of them, such as toffee, are quite difficult to get rid of. Now the modern child with the 'sweet tooth'—that means a very large

proportion of children of school age, when it buys its sweets chooses the cheaper kind, so as to get the most for its money, and also the kind of sweet that lasts longest, that is to say, the stickiest. A piece of toffee taken to bed represents sugar in a very different form from loaf sugar; the toffee itself clings to the teeth, which from the point of view of the child and of the toffee-maker is its great merit. The active movements of the tongue, cheek, and lips which during the day play an important part in cleansing the teeth, are in abeyance at night, while the flow of saliva which in the daytime helps to wash away particles of food, at night is much lessened. Under these conditions sugar can remain for a long time in contact with the teeth, and undoubtedly plays a very important part in causing decay.

Another factor that may help is that the cheaper sweets are made not of cane sugar but of grape sugar. Now both of these sugars are fermentable into lactic acid, but whereas cane sugar is changed into lactic acid in two stages, grape sugar is changed into lactic acid at once and in a shorter space of time.

Undoubtedly the increase in the habit of eating sweets must be regarded as one of the most important factors in the increased amount of dental caries, especially in children. Another factor that pre-

disposes to dental caries is an irregular arrangement of the teeth. In a normal mouth the teeth are so arranged that they are easily cleansable by the action of mastication and the movements of the tongue: as we have seen, if the food is of a sticky character this does not suffice to prevent food from adhering to the teeth, but it certainly minimizes the risk; but when the teeth are placed irregularly so that they overlap, then the chances of food clinging to the teeth are greatly increased, so that it is a commonplace of dental experience that such mouths are very prone to dental caries.

Another factor lies in the structure of the teeth themselves. If any illness or period of malnutrition occurs during the period in which the teeth are being formed, the latter are liable to defects of the enamel; this instead of being hard and smooth may be pitted and soft, and in some advanced cases almost entirely absent. Such teeth offer far less resistance to the action of lactic acid than normal teeth, while, further, their rough surface favours the clinging of particles of food-stuff.

Both of these factors, the irregular arrangement of the teeth and the defective structure of individual teeth, are important, yet far less so than the food factor.

On a proper recognition of the latter must depend all our efforts to prevent dental caries.

## CHAPTER VI

### DISEASE OF THE GUMS: PERIODONTAL DISEASE

IN the last chapter we discussed the nature and cause of dental caries; in this chapter we must now consider another important disease which affects the attachment of the teeth to the bone, not less important or common than dental caries and responsible for an equal amount of harm. Dental caries is a disease chiefly of early life, although so long as teeth are present it is liable to occur, but it is in childhood and adolescence that its ravages are chiefly apparent; later on, the very fact that it destroys the teeth limits its progress. A person who has been immune to dental caries through childhood and early life may reasonably hope to remain immune in later life, since the various factors which have combined to prevent decay will probably continue.

The disease that we are now about to describe is one of later life; its progress is slow and insidious, for it attacks the attachment of the teeth rather than the teeth themselves, and so may progress very far before the individual is aware that there is any-

thing wrong. Again, pain is not a common symptom and this helps to obscure the significance of the disease, for it is difficult to convince people that there can be any serious trouble if pain be absent. It will be

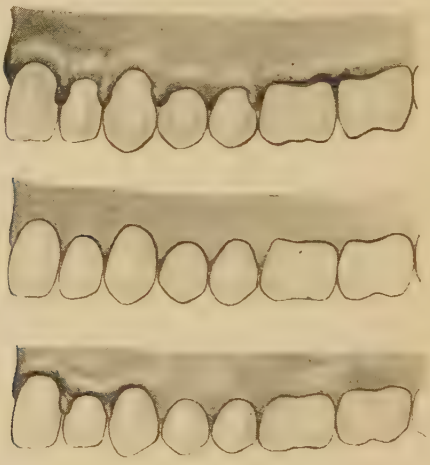


FIG. 12.

Diagrams showing the condition of the gum in health and disease. The central one shows the gum in health. The upper and lower ones show the thickened and inflamed gums in commencing periodontal disease.

remembered that, in describing the structure of the teeth, we mentioned that the tooth was attached to the bone by a membrane called the periodontal membrane ; at the neck of the tooth it blends with the gum, and the margin of the gum is raised above the point where it blends with the membrane so

that it forms a free edge or collar round the neck of the tooth. In between the neck of adjacent teeth the gum projects and forms a little triangular pad which fills up the space between the teeth. Now in this disease the first thing that happens is that the free margin of gum becomes inflamed; it is red and slightly swollen, so that the pad of gum between the teeth bulges out. The gum is a little tender and, when brushed, bleeds readily. When healthy the gum is firm to the touch and of a light pink colour, so that the contrast between the condition of health and that of disease is very marked. The next thing that happens is that the attachment of the periodontal membrane to the tooth is attacked and destroyed, so that the little trough formed by the free margin of gum around the neck of the tooth becomes deepened; as a result of this, food débris

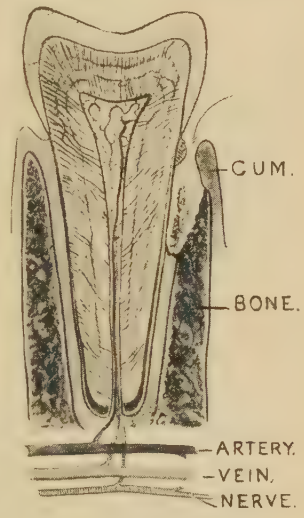



FIG. 13.

Diagram of a tooth and its attachment to the jaw. On the left side the attachment is normal, on the right side there is destruction of the bone and periodontal membrane.

and germs collect in it and stagnate, and if the gum be pressed a white cheesy substance can be expressed.

Together with the destruction of the periodontal membrane, the bone is attacked and eaten away. This goes on at a quicker rate than the destruction of the membrane; and as the bone is invisible, the real amount of destruction is concealed, and only becomes evident when an X-ray photograph is taken.

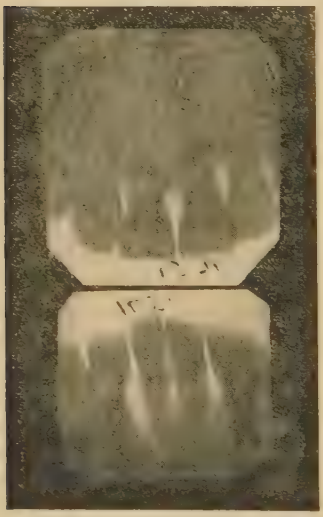


FIG. 14.

An X-ray photograph showing the destruction of bone in periodontal disease.

As the destruction of bone and periodontal membrane increases the gum shrinks or recedes, and the roots of the teeth affected are exposed, and with the loss of attachment the teeth become progressively looser. More and more stagnant food collects in the pockets, while the germs present form pus which flows into the mouth and is swallowed or is absorbed into the blood stream. Finally, the

destruction reaches a point where all the bone is destroyed and the tooth is only retained by gum; when this stage is reached the teeth become very loose and eventually fall out. Before this stage is reached the teeth become more or less encrusted with tartar which consists of lime salts deposited from the saliva, and the breath, partly owing to the accumulation of tartar and partly to the collection of decomposing food-stuff around the teeth, becomes very offensive.

The tendency is for the disease to attack many teeth, so that it is common to see mouths in which nearly all the teeth are affected and show different stages of the disease. It would almost seem that dental caries and periodontal disease are to some extent antagonistic, for teeth which are extremely attacked by periodontal disease are often singularly free from dental caries, and it is difficult to get people to realize that teeth whose crowns are sound may yet be seriously diseased. Yet a tree whose roots are attacked is more dangerous than one whose trunk is rotten even though the roots be sound.

It is very important to recognize periodontal disease early, for the dental treatment of it is at present limited; only in the early stages can it be effectively treated, and even so the tissue which has been destroyed is never replaced. In the latter stages little can be done, and consideration of health

and cleanliness often demand the extraction of many teeth as the only effectual treatment.

With regard to the cause of periodontal disease our knowledge is very far from complete.

One very common cause is the habit of mouth-breathing; this as we shall see presently most commonly arises as the result of adenoid growths blocking up the nasal passages so that the child is forced to breathe through the mouth. As a result of this the gums instead of being moist become dry, so that germs and food débris collect along their margin instead of being removed by the saliva; the effect of this is that the gums become chronically inflamed and thickened. At this stage the condition is curable if the cause, namely, the mouth-breathing, be stopped, but if it goes on, these inflamed gums become the seat of periodontal disease. Many of the worst cases of the latter condition are those of mouth-breathers, and it often occurs in quite early life.

Then again periodontal disease sometimes appears to follow an illness, one of the fevers or influenza. At such a time the vitality of the tissue is lowered and they are more prone to infection. Then too, the food taken is of a soft nature and tends to cling around the teeth, while the saliva is often deficient in quantity and so fails to exercise its full cleansing

effect, and lastly, but not least, the toilet of the mouth is often neglected at such times, so that for these various reasons a period of illness is always a period of danger for the teeth and gums unless precautions are taken.

It used to be very common for serious disease of the gums and jaws to follow scarlet fever, but since systematic cleaning of the mouth has been carried out as a routine treatment at fever hospitals, these complications have become far less common.

Another common cause of periodontal disease is what is called ' food packing.' Normally the teeth are in contact near the biting surface so that food cannot be forced down in a vertical direction, while the space between the necks of the teeth is filled up with a little triangular pad of gum which prevents food from being forced between them in a lateral direction. If for any reason either of these two defences are destroyed, the food will lodge between the teeth and be forced down against the gum. The irritation of this stagnating food ulcerates the gums and the periodontal membrane, and a pocket is formed in which more food lodges making the pocket still deeper. One of the ways in which this condition is caused is by the premature loss of a tooth ; the other teeth space out a little, and so

food is forced down at every meal and acts in the way just described.

The accumulation of tartar around the neck of the teeth is another cause. This is often seen in mouths where, owing to a tender tooth with an exposed nerve, that side of the mouth has not been used for mastication; as a result, the upper and lower teeth being deprived of the cleansing action of chewing, are coated with tartar, and when this is removed it is seen that the gums are inflamed and that destruction of bone and periodontal membrane has commenced.

A large number of cases occur, however, in which it is difficult to find a local cause. Some of them may be due to general disease such as kidney disease or diabetes. These are the cases in which all the teeth are liable to be affected, whereas in the cases in which there is a local cause, the trouble is often limited to a few teeth. Speaking generally, we may say that in most cases periodontal disease like dental caries is chiefly due to the stagnation of food; in the case of dental caries it is the sticky carbohydrate foods that cause the trouble; in the case of periodontal disease it is chiefly meat and vegetable fibres which, being forced between the teeth, cause inflammation and destruction of the soft and bony lesion around the teeth.

A special form of periodontal disease is sometimes seen in children, which is probably different in its origin from the condition seen in adults and is of a very acute nature. It occurs in young children from the ages of two or three to about seven years. They are poorly nourished and may have recently been suffering from illness. On examining the mouth of a child with the disease it will be seen that the gums are ulcerated or eaten away, so that the gum margins instead of being regularly festooned are ragged and irregular. They are extremely tender, and on pressing them pus wells up around the neck of the teeth, which are quite loose. The breath is offensive, the child may be feverish and ill. The ulceration tends to spread from the gums on to the cheeks and to form there large shallow grey ulcers. The condition is of sudden onset and spreads with alarming rapidity, and if not promptly treated may result in serious illness. Any child with such a condition should be immediately referred to a dentist or doctor.

## CHAPTER VII

### LOCAL AND REMOTE EFFECTS OF DENTAL SEPSIS IN CHILDREN AND ADULTS

THE time has long since gone by when it was possible to regard the different parts of the body as independent units, one of which could be diseased while the other remained perfectly well. We know now that all the parts of the body are linked up together, and that for weal or woe they are constantly affecting each other. What we term the general health of the individual implies a condition of well-being of all the different units which constitute our body, and that a condition of disease in any one part means not merely the disease of that part but actually or potentially is a menace to all the other parts, and so to the general health of the individual.

This view has been largely brought about by the work of Louis Pasteur, the French chemist, who showed that disease could be caused by the action of minute germs or microbes.

Many of these germs are specific—that is to say,

one particular variety of germ only causes a certain disease: for instance, consumption is caused by a certain germ, lockjaw by another. Many distinguished scientists have worked on the subject since then, and a very large number of diseases have been shown to be due to germs, and it is probable that in the end the great majority of diseases will be found to be caused by germs.

These germs are multitudinous in number; they are found in the air, the water, dust, and in the body itself. Fortunately for us only a few of them are harmful, while many are actually useful. Even so the number of harmful ones is very great, so it would seem on the face of it wonderful that we should survive in good health. But Nature in her turn has provided in our bodies an elaborate mechanism of defence. In the blood and lymph stream there are certain cells called the white corpuscles whose business it is to guard our tissues from the invasion of harmful germs. These are like a watchful army ever circulating around the body and defending it from harm.

When we are in good health it means that our white corpuscles are efficiently protecting us. If at any point owing to an injury the harmful germs break through, the white corpuscles rally to that spot; if they are able to kill the invaders, then the

local health of that part is re-established ; if not, a diseased condition commences. The white corpuscles may be sufficiently strong to surround the diseased part and prevent it from spreading, and, after a time, healing ensues. But it may happen that the germs are too strong and the disease goes on spreading. Sometimes the invasion is so formidable that the white corpuscles are unable to offer any effective resistance, and the infection spreads widely, causing a generalized blood poisoning which may result in death. Now it is important to realize that wherever infection takes place that it may spread in several ways. It may spread by direct continuity, as in periodontal disease, where we see that the condition spreads from the gum to the periodontal membrane and from thence to the bone, these tissues being all adjacent to each other. It may also spread along the blood and lymph stream, for these which convey our white corpuscles to different parts of the body, if the infection be a strong one, may also serve to carry the germs to different parts of the body.

Let us illustrate how infection occurs, and how it is combated by a series of effects which are often seen.

If a clean cut be made in a finger and no germs get in, the cut heals very quickly. If germs enter the wound the healing is delayed, for the germs have to

be killed by the white corpuscles ; the result of this battle is seen in the shape of a small abscess, and healing does not occur until the abscess bursts or is opened. If the infection is greater, a larger abscess forms which may extend deep into the tissues forming a whitlow. Here we have the infection spreading by direct continuity. A further stage of infection may occur in the form of germs or other poisonous products spreading along the lymph vessels of the arm and causing an enlargement of the glands in the armpit ; the glands enlarge because they have become infected by the germs which entered the cut in the finger, and the germs have reached the glands by travelling along the channels which ordinarily serve to convey the defensive agents of the body to the finger. This is an example of a remote infection arising from a local infection. Such a condition is dangerous because it shows that the natural defences of the body have been overcome. The battle may still be gained, however, for the glands are storehouses of the white corpuscles and so have a high resistance, and the infection may be held up at this point and prevented from spreading further, especially if aided by surgical treatment, and after a period of illness recovery may follow.

Finally, the infection may be so severe that the glands cannot cope with it, the germs and their

poison become disseminated throughout the body causing a general blood poisoning from which recovery is rare. Now wherever we have a local injury accompanied by infection such a sequence of events may occur.

In the heading of this chapter the words ' Dental sepsis ' were used, and their meaning must be explained. By sepsis is meant a condition of infection caused by germs capable of causing disease, and dental sepsis means a condition of infection caused by disease of the teeth. Wherever we have a condition of disease in the teeth or in the tissues surrounding the teeth there we have a condition of dental sepsis, so that both dental caries and periodontal disease are alike included in the term dental sepsis.

Now the mouth is the great portal of the body ; all the food we eat passes through it into the stomach and intestines. Air is constantly passing through it into the lungs, while it is closely related both to the nose and to the ear. Any condition of infection in the mouth may therefore result in the food we eat becoming contaminated and so harming the lining membrane of the stomach and intestines. The air we breathe may become infected with germs from the mouth, which are thus carried into the nose and ear and may set up disease of these parts, and finally germs and their products may be absorbed

into the blood and lymph stream which nourish the tissues of the mouth, and be carried to remote parts of the body which in their turn become infected. Doctors are more and more coming to believe that infection of the mouth plays a great and important part in the causation of disease in other parts of the body.

Let us now consider some of the results of dental sepsis in children and adults.

Now in children who are actively growing the importance of perfect health is very great if perfect growth of the body is to take place, whilst the resistance of the child to infection is proportionately less than in the adult. Dental sepsis has therefore very marked results in children. An examination of a large number shows that a very large proportion of those who are suffering from dental sepsis have the glands under the jaws and down the neck enlarged; many of them have enlarged tonsils, and many have discharge from the ears. Now any or all of these conditions may and often do arise from dental sepsis, and none of them are trivial. The glands in the neck often swell to a large size, and sometimes become the seat of abscesses which burst, leaving ugly scars. Again, and this is of extreme importance, these glands when infected from the mouth have their vitality diminished, and in some

cases they afterwards become infected by the germs of tuberculosis which may spread to other parts and cause a very serious illness.

Another result of dental sepsis in children is

FIG. 15.

Photograph of a boy with adenoids and nasal obstruction. Note the open mouth, vacant expression, and the poor development of the chest.

enlargement of the tonsils with which is often associated adenoid growths at the back of the nose. Such children are liable to sore throats and colds, while the inflammation at the back of the nose may spread up the Eustachian tube to the ear. This latter complication is very important; it leads to a

chronic discharge from the ears, which sometimes becomes acute with serious results, while impairment of hearing and even total deafness may result. These results may all arise from a direct spreading of the infection from the mouth, and they are sufficiently serious, but there is still another way in which the enlargement of the tissues and the presence of adenoids affect the child's health, and that is by preventing nasal breathing. The nose acts as a filter to the air and helps to prevent germs from being taken into the lungs, but if a child has its nasal passages blocked up by adenoids it breathes through the mouth instead; the air is not filtered, and the infection of the throat and lungs is rendered possible. Then again the nose not being used for breathing does not expand properly, so that such children have narrow pinched nostrils. The lack of growth of the floor of the nose is followed by a lack of growth of the roof of the mouth, so that the roof is high and vaulted. At the same time the tension of the cheeks due to the mouth being constantly open exerts pressure on the upper jaw which is easily moulded in childhood and compresses it laterally. The effect of this is seen in the dental arch which, instead of being broad and horseshoe-shaped, becomes V-shaped, so that the front teeth become unduly prominent while the back teeth are often crowded. The

FIG. 16.

Models of a normal jaw (upper fig.), and a jaw showing the effect of nasal obstruction (lower fig.). The latter shows a narrow arch and prominence of the front teeth.

expression of the face of these children is so characteristic as to be easily recognized. The mouth is constantly open, the upper incisor teeth are exposed like the teeth of a rabbit and project forward; the upper lip is drawn up; the nose is narrow and the nostrils small, while the child has a somewhat sleepy and stupid appearance. The child is undersized and of poor development, the chest narrow, and its movements in respiration poor. Mentally the child is sluggish, because the deafness which so often accompanies nasal obstruction handicaps the child at school, for in a large class the deaf child is at a great disadvantage, indeed such children are often regarded as mentally dull or even deficient. When the nasal obstruction is removed, although the moulding of the face and jaw may permanently remain, the effect on the child's mental and physical development is often little short of marvellous: the deafness vanishes, the liability to cold goes with the re-establishment of nasal breathing, the general physique improves, while the mental dullness is replaced by alert intelligence.

The results of mouth-breathing and nasal obstruction have been described at some length, for they are very various and exercise a most serious effect on the whole being of the child, and in a great number of cases their origin can be traced to dental sepsis.

In the adult the effects of dental sepsis are not less important, though of slower onset and more insidious, and perhaps more difficult to trace home to their original cause.

In the adult the resistance to disease is higher, while the infection being more gradual, the body has more time in which to elaborate an adequate defence ; nevertheless the evil effects of dental sepsis are equally important and even more widely spread than in the child.

Dental sepsis in the adult may arise from dental caries, through the stagnation of food débris and germs in the cavities so caused from abscess formation around the root of a tooth as a sequel to decay of that tooth or from periodontal disease. Of these the two last conditions are the most important.

To consider the local effects first : an abscess in connection with a tooth may attain considerable size without bursting. As it grows, room has to be made for it, and this is attained by a destruction of the bone of the jaw, so that even when the abscess is cured the loss of bone remains permanent. In the upper jaw the abscess may extend to a large cavity in the jaw called the antrum, and as the antrum opens into the nose, this may be the beginning of chronic disease of the nose. Then again the abscess may extend into the soft tissues giving rise to great

swelling, and as the soft tissues offer less resistance to its spread than does the bone, the mischief may extend a long way from the original source. Thus the abscess may track down into the neck, or it may pass backwards behind the throat and eventually reach the brain, both of them serious results and attended with grave risks to life. Short of these calamities much disfigurement may result from the abscess bursting externally on the face ; the opening thus made may persist for a long time, and when eventually it does heal an ugly puckered scar is left.

Death of some of the bone of the jaw is a very common sequel to an abscess ; in some degree it is almost always present, but occasionally a considerable portion of the jaw may die as a result of an abscess in a tooth. In one case that came under the writer's observation, in a boy of nine, the greater portion of the right side of the lower jaw was destroyed as the result of an abscess of the first permanent molar. The subsequent disfigurement was very great, and, of course, permanent. The presence of dental sepsis is often a determining factor in the occurrence of other diseases of the mouth and jaws. Thus the disease called ' fossy-jaw ' which attacks workers in phosphorus and in match factories and causes death of the jawbone, has been found to occur only

in those whose mouths were in a dirty condition: and since Government regulations have made compulsory the dental inspection of workers in match factories, the disease has become very rare.

Again, mercury poisoning which may occur in mercury mines, or as a result of the administration of mercury for medicinal purposes, so far as its effects on the gums and jaws are concerned, depends chiefly on the presence of dental sepsis. If the mouth is clean mercurial poisoning, unless the dose is excessive, does not occur, but if the mouth is dirty it is liable to affect the mouth, causing an acute inflammation of the gums, loosening of the teeth, and death of the jawbone. Dental sepsis also plays a part as a predisposing cause of cancer, especially of the lips, tongue, cheeks or gums. It is a characteristic feature of cancer that it is always preceded by a chronic irritation of the part due to some inflammatory condition, and so far as the mouth is concerned, the commonest cause of chronic irritation is undoubtedly dental sepsis. For instance, the sharp edge of a decayed tooth may irritate the tongue and cause a small ulcer: at first this is of an innocent character, and if the cause, namely, the tooth, be removed the ulcer will soon heal up, but if the irritation continues there is always a possibility that the ulcer will change its nature and become definitely

cancerous, so that the removal of the tooth will no longer bring about a cure.

Again, cancer has been sometimes known to occur at the gum margin in cases of periodontal disease.

Coming now to consider the remote effects of dental sepsis, these occur either by the swallowing of pus formed in the pockets around the teeth or by the absorption of the pus into the blood and lymph streams. It is not possible here to do more than enumerate briefly some of the more important diseases which have been found to be associated with dental sepsis.

Indigestion is one of the commonest conditions found. This is partly due to inefficient mastication of the food, either because the teeth are tender or because they are deficient in number, and partly due to the constant swallowing of small doses of the poison formed in the gum pockets. The removal of the diseased teeth alone, even without supplying the patient with artificial substitutes, often brings about a cure of an indigestion of many years' standing.

Diseases of the blood, such as the anæmias, are often associated with dental sepsis; indeed, according to Dr. Hunter, dental sepsis is perhaps the commonest cause of one of the most serious forms of anæmia known as pernicious anæmia.

Rheumatism, especially that form affecting the

joints, is also among the effects of dental sepsis; the poison from the gums is absorbed into the blood stream and settles in the smaller joints causing enlargement and stiffness. Many striking cases have been recorded where the removal of the dental sepsis has resulted in a very marked improvement of the rheumatism. Many ophthalmic surgeons are of the opinion that some of the inflammatory conditions of the eye are caused by dental sepsis, and many of them now insist that before an operation on the eye is performed that the mouth be put into a clean condition.

There can be little doubt that in the past many cases of deaths from infection following severe operation on the mouth were due to dental sepsis, and it is becoming generally recognized that a thorough cleaning of the mouth before such operations are performed is an essential preliminary.

Apart from these cases of specific disease associated with dental sepsis, there are a large number of cases in which people are generally ' below par ' because of their dental sepsis. They are easily fatigued, the skin is muddy or sallow and the appetite poor, while their work is a strain instead of being borne easily. In other words, they are suffering from a slow absorption of small doses of poison. The source of the poison may be elsewhere than in the

mouth, but often the only obvious source is the mouth, and every dental surgeon has seen cases in which the removal of the dental sepsis has resulted in a striking improvement in the general health.

Even in these numerous cases in which the general health appears to be good although dental sepsis is present, it should be remembered that the dental sepsis must always be a potential source of danger which may at any time be converted into an actual source of danger.

## CHAPTER VIII

### IRREGULARITIES OF THE TEETH AND THEIR CAUSES

IN the chapter on the cause of dental caries it was stated that among the predisposing causes were irregularities of the teeth, which act by making it difficult both for normal and artificial methods of cleaning the teeth to operate.

In this chapter some of the common types of irregularities of the teeth will be described; since most of them are due to conditions occurring in childhood, their recognition by parents is of importance. Irregularities of the teeth are due either to congenital or acquired condition. By congenital condition we mean some defect present at birth so that the subsequent development of the teeth proceeds along wrong lines. The discussion of these does not fall within the scope of this book, but amongst them we may mention cleft palate, absence of teeth, or their development in an abnormal position; the jaws may be too small, or they may not grow properly, so that there is not sufficient room for the erupting teeth. Some of these conditions

can be remedied by appropriate treatment, while others cannot be so treated, and remain through life. Irregularities due to acquired condition are more frequent than the others and of greater importance, since they are usually preventable, or, if not prevented, can often be successfully treated. They may be due to habits formed in infancy and childhood, to methods of feeding, to diseases of the mouth and nose, or to dental disease of the temporary teeth affecting the permanent teeth. Irregularities of the temporary teeth are quite common and should never be regarded as trivial, since they usually prefigure an irregularity of the permanent set.

Among the habits which induce deformities of the jaws are the use of a comforter, thumb sucking, finger sucking, tongue sucking or biting the tongue.

The use of the comforter or dummy teat is a prolific cause of irregularities; the constant pressure of the teat presses forward the front teeth and causes them to protrude. Apart from the deformity so produced, the use of the comforter is to be condemned on the score of uncleanliness. It is common to see the comforter fall to the ground and be picked up and replaced in the child's mouth, regardless of any dirt on it; while it is common for the teat to be dipped in sugar or jam to soothe the child, with

the result that the first teeth become terribly decayed.

Thumb and finger sucking is another important cause. The thumb may be placed in the mouth with the nail surface downward so that the broad surface is pressed with considerable force against

FIG. 17.

Models of the jaws of a child who had used a dummy teat, showing the protrusion of the upper front teeth caused by the habit.

the upper incisors; at the same time the lower incisors are pressed inwards, thus giving rise to considerable protrusion. Another variety of the habit is for the knuckle to be placed in the mouth and bitten; the effect of this is to force the upper and lower incisors into their sockets, so that when the back teeth meet there is a gap between the upper and lower incisors.

Finger sucking operates in the same way as thumb sucking, and the child may suck one or two fingers. If the fingers are placed with the fleshy surface uppermost, a protrusion of the upper incisors results. If the fingers are hooked into the mouth, the lower incisors may be pulled forward and a gap between the upper and lower incisors be produced.

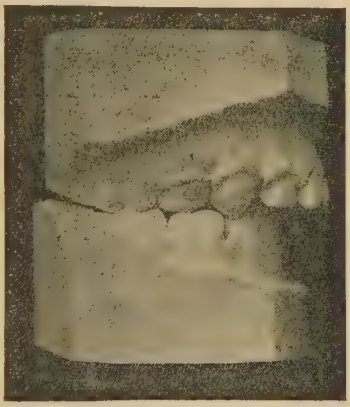


FIG. 18.

A model illustrating the deformity caused by finger and thumb sucking.

These habits once formed are difficult to check, but as their effect is so important, every effort should be made to stop them. During the daytime constant watchfulness on the part of the parent or attendant may be sufficient. Whenever the thumb goes into the mouth the child should be told of it, for the habit often becomes an unconscious one. Some children can be shamed out of the habit, but others are indifferent to remonstrance, and much patience is needed before success is gained.

With many children the habit is chiefly indulged in at night time. Most children and some adults have some little trick whereby they induce sleep, and directly the child is laid in its cot the thumb is inserted into the mouth and the child goes comfortably off to sleep. The writer has known of children who have kept up the habit of thumb sucking at night until their childhood days were nearly over.

Various methods may be tried : tying up the hand in a linen or woollen bag is sometimes successful. It might be thought that sucking wool was so disagreeable as speedily to bring about a cure, and yet it often fails. With babies, tying the hands to the nightgown is often successful, although some disturbed nights may have to be faced until the habit is broken. Smearing the thumb or finger with bitter aloes is another method sometimes successful, sometimes not.

If these various methods fail then a small aluminium plate should be made to lie between the teeth and the lips which effectually prevents the habit. There is no risk of these plates being swallowed, and they are easily tolerated. The writer has made such plates for children as young as four years with complete success in stopping the habit of thumb sucking at night.

Were the importance of checking such habits

recognized, doubtless more strenuous efforts would be made by parents to break them, but the habit is often regarded as trivial, and the effect on the teeth not realized, and so the habit goes on unchecked. Perhaps a few remonstrances are made, and if the child still goes on doing it, the parents cease to worry.

It is useless to address an intermittent warning to the child ; it should *never* be allowed to suck its finger or thumb without being told of the fact. The constant repetition of the warning has a cumulative effect in the child's mind, and in the end will induce a volition in the child's mind in the direction of ceasing the habit.

The habit of tongue sucking, though not so common as thumb sucking, is yet frequent, and quite important in producing irregularities. The tongue may be pressed against the upper incisors, or more commonly it is protruded between the upper and lower incisors, and rests just between the lips which suck the tip. The result is that the upper incisors are pushed forward, and in addition a space between the upper and lower incisors is produced. As the habit is quite inconspicuous, it often passes unnoticed, and once formed it is difficult to check. The aluminium plate so effective in thumb sucking is of no use, for the child can still press the tongue

forward, the pressure of the lips not being sufficient to counteract the pressure of the tongue.

A device that sometimes succeeds is to make a little vulcanite plate which fits the palate of the upper jaw; the vulcanite is thickened in front so that it extends a little below the tips of the upper incisors, and when the child attempts to protrude the tongue the tip of it impinges against the flange of vulcanite and so is prevented from passing out between the teeth.

A rarer form of tongue sucking or biting is for the tongue to be placed on one or other side between the molar teeth and bitten upon. If the teeth are erupting they may be prevented from coming through, or they may be forced up into the gum so that a gap is left between the upper and lower molars.

Methods of feeding may operate in producing irregularities in two ways.

Firstly, there may be a general lack of growth of the jaws because the proper stimulus to growth is lacking, so that there is not sufficient room for the teeth.

It is universally admitted that the growth of a part depends on its receiving a proper amount of work to do. What is termed its functional activity acts as a stimulus to growth.

Nature intended the teeth and jaws to work hard,

by so doing the supply of blood to these parts is increased and growth proceeds properly. If they do not receive sufficient work, the blood supply is diminished and their development proceeds imperfectly. If the food be of so soft and pappy a nature that the teeth do not need to masticate it, then the stimulus to growth is lessened and a general undergrowth of the jaws results. This must be regarded as a very potent factor in producing irregularities at the present day, although it is not possible here to discuss it fully.

It has been shown by a series of measurements of models of the upper jaws of children that the arches of breast-fed children are slightly broader than those of bottle-fed children, so that irregularities are more likely to occur in the latter, and it is worth while to consider the causes of this difference in development. When a child is fed at the breast it takes into its mouth not only the nipple but some of the breast substance, and it takes in the milk not so much by a sucking action but by pressing the breast tissue. If the act of suckling were an aspiratory action, a vacuum would be created in the mouth and the cheek would be drawn in, thus exerting lateral pressure on the jaws and tending to narrow them. This is not so, and a tendency to forming a vacuum in the mouth is furthermore prevented by the mass

of breast tissue lying in the mouth and exerting a moulding action in the jaws in the direction of spreading them out. In bottle-fed children these factors do not operate. Not so many years ago the bottle mostly in use was the bottle with an indiarubber tube several inches in length; apart from its uncleanliness, the use of the bottle undoubtedly deformed the jaws, for in order to draw up the milk the child had to suck vigorously, and the cheeks being drawn in by the sucking action exerted considerable tension on the jaws, which, being easily moulded, were narrowed transversely. Happily such bottles are now almost extinct, and in Germany their use is illegal.

A dental surgeon recently appointed to the Falkland Isles stated that he found this type of bottle extensively used, with the result that protrusion of the front teeth was extremely common, and one of his first acts was to introduce the modern type of boat-shaped bottle.

The latter type of bottle does away with the worst features of the tube bottle, namely, its uncleanliness, and the necessity of vigorous suction on the child's part to get the milk, but it still lacks the positive action of breast-feeding in moulding and expanding the jaws. The teats are too small, and should be at least as large as the index finger.

We see, therefore, that the bottle-fed child at the very outset of its life lacks one very important stimulus to growth of the jaws that the breast-fed child possesses. The widespread effects of nasal obstruction, often due to dental sepsis, have been described in a preceding chapter, but the rôle of nasal obstruction in producing irregularities is of such paramount importance that we shall refer to it again here.

The partition of bone lying between the nose and the mouth forms both the floor of the nose and the roof of the mouth, and if it does not develop properly the result is seen in a narrowing of the floor of the nose and also of the roof of the mouth, and this actually happens when the nose is not used for breathing. When the nose is used for breathing the mouth is kept shut and the tongue normally lies against the roof of the mouth, filling it up and tending to spread out the dental arches laterally, an action which is aided by the pressure of the closed lips on the front teeth. When the mouth is used for breathing it is kept open, and the tongue instead of lying against the roof of the mouth lies in the floor of the mouth, so that the upper arch no longer possesses the moulding action of the tongue.

Again, the mouth being constantly open, the cheeks instead of being relaxed are slightly stretched

and press against the sides of the dental arch compressing them laterally: the result of this is that the dental arch is narrowed transversely, so that

FIG. 10.

A model of an upper jaw in a case of nasal obstruction and mouth breathing. The arch is narrowed so that there is no room for the eye teeth.

the front teeth are forced to take up a position more anterior than normal, which they do the more easily as the upper lip, being drawn up, no longer exerts any countervailing pressure.

The result of these positive and negative factors

is seen in the shape of a high vaulted roof, a narrow dental arch, and prominent front teeth. The condition is accentuated when the upper canine teeth begin to erupt at about the age of eleven years; they are crowded out of the arch, and instead of coming into line with the other teeth erupt outside the arch, giving the child a ' tusky ' appearance. Readers of Scott's novel *Quentin Durward* will remember how Count de la Marck gained his name of the ' Wild Boar of the Ardennes ' from the extreme prominence of his canine teeth, which obviously had erupted outside the arch.

Although the irregularities of the teeth are chiefly important as predisposing to dental caries yet they are important on the æsthetic side, and this more than the other often drives parents to seek advice for their children. From the point of view of appearance the effects of mouth breathing in a young child are at first slight. Indeed, the retracted lip and narrow nostrils often give a certain charm to the face, as those who know Vermeer's famous portrait of a young girl in the gallery of the Hague will readily admit. But it must be remembered that the irregularity increases, and that when the permanent incisors become prominent, often to an extreme degree, they constitute an appearance the reverse of charming.

Another frequent cause of irregularities of the permanent teeth, with which may also be grouped a defective development of individual teeth, is dental disease of the temporary teeth leading to their early loss. This factor may operate in three ways :

Firstly, the proper arrangement of the permanent teeth depends on their orderly succession in their right places, and this again depends on the temporary teeth lasting until they are displaced by their permanent successors. As previously stated, the first permanent molars erupt behind the second temporary molars ; now if these latter decay and are lost before the first permanent molars erupt, these are likely to move forward so that there is insufficient room in the jaws for the premolar teeth which succeed the temporary molars ; as a result the premolars may be crowded out and take up an irregular position, or the space may be so diminished that one of them is unable to erupt at all.

Another thing that may happen is that if the second temporary molar is prematurely lost, the first premolar erupts and moves backward towards the first permanent molar, thus crowding out the second premolar. Early loss of the temporary incisors may lead to a narrowing of the space by the pressure of the cheek and lips, so that the permanent incisors are crowded and may be twisted or overlap each

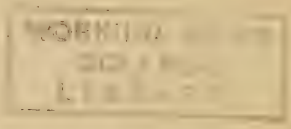
other. If the first permanent molar decays early, as so often happens, the second permanent molars, which come through at about the age of twelve, tilt forward so that the anterior cusps do not meet the corresponding upper teeth, and so the child loses some of its masticating surface.

Secondly, irregularity of the permanent teeth may be caused by the temporary teeth not being absorbed properly by the underlying permanent teeth. When a temporary tooth decays so much that only the roots are left in the gum, the permanent tooth appears to be unable to absorb the piece of root because the latter is infected; it therefore, so to speak, dodges the obstruction, and is very likely to erupt by the side of the root, and is thus displaced from its proper position in the arch: this type of irregularity is usually limited to one or two teeth, and is usually seen in the incisor and premolar region.

Thirdly, the structure of a permanent tooth may be affected by disease of the overlying temporary tooth. If a temporary molar decays so that the nerve dies and an abscess is formed, the pus may extend into the jaw and poison the developing permanent tooth beneath; this may go on to such an extent that the permanent tooth is entirely destroyed, but usually it affects the crown, since that lies between the roots of the temporary molar, and damages it to a varying

degree. The enamel is badly formed, or may be entirely absent, or the dentine is sometimes affected as well, so that when the tooth erupts it looks as though it were a decayed root of the temporary molar. This variety of irregularity is almost entirely limited to the premolars, and it is not uncommon to see a mouth in which all the teeth are well formed with the exception of one premolar.

Such are some of the chief causes of irregularities of the teeth, and it will be apparent that most of them are preventable. Since irregularity of the teeth are not only æsthetic defects but also predispose strongly to dental disease, every effort should be made to prevent them arising, and if they are present advice should be sought with a view to remedying them if it is possible to do so.



# CHAPTER IX

## THE PREVENTION OF DENTAL DISEASE

IT is an old adage that prevention is better than cure, and more and more medical science is becoming a matter of preventing disease; for only to be able to cure a disease, however valuable a power, is after all a confession of ignorance.

Now in order to be able to prevent a disease we must be acquainted with its causes; and in the case of dental disease we know some of the causes, although our knowledge is yet far from complete, and it is probable that even under the most ideal conditions dental disease could not be wholly prevented, but we know sufficient of its causes to be able to say confidently that dental disease is a preventable disease, and that it is in the power of the community to prevent a very large amount of the dental disease now so prevalent, and that with regard to the proportion of disease due to causes unknown, and therefore not preventable, it would be so small in amount that it could effectively be coped with by curative measures.

Now the means of preventing dental disease may be compared to two lines of defence.

The first is the natural line of defence, and is the more important. As we have seen, Nature has provided certain ways by means of which food can be prevented from stagnating in the mouth, and it should be our business to see that every child is placed in such an environment that the natural lines of defence are so strong as to be completely effective. These natural methods of protection may be compared to an endless chain which is strong only so long as all the links are intact, but when any link is broken then the defect leads on to other defects, until it becomes impossible for natural methods alone to prevent dental disease from occurring; and so we must have a second line of defence, and by that we mean various artificial methods of keeping the mouth clean. These methods cannot replace Nature's methods, they can only reinforce them, but as there are so many factors which tend to prevent that perfect environment in which Nature can work at her best these artificial methods are of considerable importance, and, if carefully carried out, may help to overcome many conditions which would otherwise predispose to dental disease.

Now the care of the teeth to be effective must begin with the child's life, even before its birth, since,

as we have seen, the teeth commence to be formed before the child is born.

The keynote to the prevention of dental disease is the prevention of the stagnation of sticky carbohydrate food around the teeth. This depends on several things: firstly, the teeth must be well shaped and of good structure; secondly, they must be arranged in broad even arches, and each tooth must be in close contact with its neighbour so that food does not get jammed between them; thirdly, the muscles of the tongue, lips, and cheeks must be well formed so that by their movements they may help to keep the teeth clean; fourthly, the teeth of the upper and lower jaw must meet in proper contact so that the food can be masticated properly, since food when well chewed has far less chance of adhering to the teeth than when it is only partly chewed; fifthly, there must be a free flow of clear limpid saliva to act as a natural mouth-wash, and to wash away any particle of food not removed by the tongue, lips, and cheeks; sixthly, the food itself must be of such a nature that it does not tend to stick to the teeth: it must be sufficiently hard and fibrous to be self-cleansing in character and to give the teeth a proper amount of work to do; seventhly, the health of the child must be good, for proper growth of the teeth, jaws, and muscles can only occur

in a healthy child. Lastly, there must be an entire absence of any obstruction to nasal respiration.

Now this may seem a somewhat formidable catalogue of ideals, and yet they are all interdependent, and obtainable not by any expensive or laborious methods but by following a few simple rules.

For the first nine months of an infant's life the proper food for it is its mother's milk. A breast-fed child is much more likely to be healthy than a bottle-fed child, and the condition of health favours a proper growth of the whole body including the teeth and jaws. But in addition suckling has a specific effect on the development of the jaws. As was described in the chapter on Irregularities, the act of suckling has a moulding effect on the jaws of the greatest importance, so that at the very commencement of life we have in breast feeding a factor in causing a proper development of the jaws which cannot be replaced by any artificial method of feeding nor by any subsequent care of the teeth in later life.

If the child cannot be breast fed—as, unfortunately, is often the case—the milk either of the cow or goat must be given; this may suffice to keep the child healthy, but it does not give the specific stimulus to growth of the jaws that the act of suckling provides. On no account should patent foods be given, for they are apt to cause rickets, and that is a disease which often causes the teeth to be imperfectly formed

and late in appearing. When the child is weaned and the teeth are beginning to erupt, then food can be given which will need some mastication. This book does not pretend to be a manual of dietetics; the subject is only dealt with in so far as it has a bearing on dental hygiene, but it can be stated emphatically that a child of two or three years is quite capable of eating food moderately hard, and only good can come of its doing so. It is common to see parents carefully cutting off the crust of a piece of bread and butter, thus taking away the best part of it, with the idea that the crust is too hard for the baby teeth.

The result is that the child soon gets into the habit of refusing to eat any food that needs mastication, and the habit thus formed is difficult to break. The habit of chewing the food well is of the greatest importance, since in chewing the muscles of the tongue, cheek, and lip, and the muscles attached to the jaw, are exercised and grow properly, while a free flow of saliva results. Like other good habits it is best formed early in life.

With regard to the food that should be given I cannot do better than quote the words of Dr. Sim Wallace, who has devoted much time to a study of this and kindred problems:—

During the first two and a half years of life all starchy or sugary foods (except milk) should be given

in a firm or fibrous form, so as to stimulate mastication and insalivation and thus promote the healthy growth of the jaws and the regular arrangement of the teeth. Bread, rusks, or any other starchy food should never be added to or soaked in milk. Bread with crust and butter, toasted bread and butter should form a considerable part of the solid part of the meals habitually given to children of this age. As the infant passes from the milk diet to the more solid diet, the milk should be more and more diluted with water. During this period the solid food should be eaten first and the milk and water taken after.

After the age of two and a half years children should always have a considerable amount of the starchy food in a form which will stimulate a pleasurable amount of efficient mastication.

The albuminous (i.e. fleshy) part of the food should also be presented in a form which will encourage mastication: for example, boiled fish, meat, and later bacon. Milk and milk substitutes should only be allowed in small amounts.

The meals should be arranged in such a way that if soft starchy or sugary food has been eaten, the mouth and teeth shall be cleansed by food of a cleansing nature taken immediately after. Thus when sweets of any kind, for example, milk puddings, jam rolls, cake, sweet biscuits, bread and marmalade or jam are eaten, fresh fruit should be eaten afterwards.

Three meals daily are to be preferred to any greater number, as the longer the interval the more hygienic is the state of the mouth and stomach, and therefore the more perfectly adapted for the reception of a further meal.

Sweets, chocolate, or biscuits and milk should never be eaten between meals or before going to bed.

Dr. Sim Wallace has further compiled a list of food-stuffs into the two groups of cleansing and non-cleansing, which are appended.

## Food-stuffs and Dental Caries

| Not Cleansing and liable to induce Dental Caries. | Cleansing and Prevention of Dental Caries. |
|---|---|
| Starchy and sugary food in general without fibrous element. | Fibrous foods generally. |
| Examples: Sweet biscuits and cake, bread and marmalade, bread and jam, new bread without crust, bread soaked in milk, milk puddings, porridge and milk, preserved fruit, chocolate, and sweets of all kinds, honey. | Examples: Fish, meat, bacon, poultry, uncooked vegetables, lettuce, cress, radish, celery. Cooked vegetables are as a rule cleansing, but in a less degree than uncooked vegetables. |
| Liquids: Cocoa and chocolate. | Stale bread with crust, toasted bread of all kinds, twice-baked bread. |
| The above foods should not be eaten except when followed by foods of a cleansing kind. | Savouries: Fresh fruit, especially those requiring mastication, e.g. apples; fatty foods, e.g. butter and margarine. |
| | Liquids: Tea (preferably Russian fashion), coffee, buttermilk, water, also soups and beef tea. |

A study of the above rules will show that to arrange the order and nature of the food so that it should leave the mouth in a clean state does not mean any radical change of diet, nor does it involve any extra expense. Obviously many of the foods of the non-cleansing order cannot be dispensed with, although they might be used to a lesser extent than at present. If a change were made so that our food consisted to a greater extent of the self-cleansing foods, it could still be made sufficiently nutritious, and, what is perhaps more important, sufficiently pleasing to the palate. People tend very much to get into a routine in the matter of food: the man who has been accustomed to finish his dinner with suet pudding or jam roll from his childhood days, acquires a habit that is not very likely to be broken; but if parents were to arrange their children's meals so that the food in itself and in the order in which it is taken was of a cleansing nature, the habit of liking such food would be unconsciously acquired, and so by preference he would continue the diet in later years.

One or two points of the preceding rules may be emphasized further. Firstly, the question of sweets: there is no doubt that the habit of eating sweets has increased enormously of late years, and there is equally little doubt that both from the dental and

the general health point of view the habit is a bad one, when as frequently happens they are eaten in considerable quantities and between meals. It is not, however, likely that a habit in itself so pleasant is ever likely to disappear; at the most it can only be regulated. It is often said that the liking of children for sweets is an evidence of their physiological necessity, and that the habit should not be checked. While it is true that the child actively growing and constantly using up a much larger store of energy in proportion to its size than the adult needs a considerable amount of starchy sugary food wherewith to supply that energy, it is absurd to contend that sweets can supply that need to any appreciable extent. We must rely for our nutrition not on the luxuries of diet but on the staple articles of diet; when the luxury is used to the extent of replacing a necessity it ceases to be a luxury and would soon cease to be desirable. It is true that sweets consisting of sugar can be utilized by the body to supply energy, but at the most they are only accessories of diet; were a child to eat sweets in sufficient quantities to supply the energy usually derived from bread, potatoes, milk, etc., it would soon be ill, and, like the confectioner's assistant, come to loathe sweets as an article of diet. So much nonsense has been talked about the so-called 'physio-

logical craving for sugar' that it is necessary to insist strongly that sweets are only luxuries, and that, assuming the craving to exist, it is supplied in full measure by the ordinary diet of life.

It should be remembered that the taste for sweets in childhood only comes into being because the parents give their children sweets, and further, that they are usually given at such times and under such conditions that the children, young as they are, soon realize that the sweets are luxuries, and as such possess a charm over the mere necessities of life. It is a pity that the habit, which when carried to excess undoubtedly harms the teeth, should be so fostered. If sweets are to be given let it be only at meal-times, so that the child comes to regard them as coming in the normal course of events and not as special treats out of the ordinary; by so doing the child is as little likely to exceed in the matter of sweets as in the matter of meat or potatoes. Above all, sweets should never be given as bribes or immediately before going to bed, while children should be discouraged from spending their pennies at the sweet-stuff shop.

Another point that should be emphasized is the necessity of allowing at least an hour to elapse between the last meal and bedtime. If this is done, the movements of the tongue, lips, and cheeks, aided

by the normal flow of saliva, will all help to cleanse the teeth of any débris.

If the child goes to bed immediately after a meal, or if, which is much worse, it is allowed to take with it a biscuit to eat in bed, we get a condition which can only result in harm. The teeth are coated with a layer of sticky, starchy food ; the natural cleansing agents, namely, the tongue, lips, and cheeks, are in abeyance since the child is at rest, while the flow of saliva is also diminished, so that the food is undisturbed for many hours, fermentation goes on with the formation of acid which soon causes decay.

So much then for the first line of defence ; now we must consider the second line of defence, namely, artificial methods of cleaning the teeth.

These are :—

1. The toothbrush.
2. Tooth powders and pastes.
3. Floss silk.
4. Toothpicks.
5. Mouth-washes.

### The Toothbrush

Much has been written on the subject of tooth-brushes both for and against, and there has been a tendency of late years to belittle their use or even to regard them as a cause of harm.

Used injudiciously the toothbrush can cause harm: vigorous brushing in a transverse direction in conjunction with the use of a gritty powder can wear grooves in the teeth and cause the gums to recede, but if used properly they are a very useful adjunct in cleaning the teeth.

The brush used should be small, the bristle-bearing part being not more than one inch in length; the

FIG. 20

The right kind of toothbrush.

bristles should be stiff, and retain their stiffness after use. The bristles themselves should not be all of the same length; a good form is that in which the bristles are in three rows, the middle row being taller than the outside rows, so that the surface is serrated and can penetrate between the teeth. Most of the brushes on the market are far too big and too soft. It is not possible by using a big brush to clean several teeth at once; each tooth must be brushed separately, and this can only be done with a small brush.

After being used, the brush should be rinsed thoroughly under the tap and dried.

Some dentists have advocated boiling the brush after use lest it should become a source of infection; this is scarcely practicable, but it might be well to keep the brush in a weak solution of carbolic acid.

All surfaces of the teeth should be brushed, and the movements should be in both a transverse and an up-and-down direction, always from the gum toward the tooth, *never* from the tooth toward the gum. The masticating surfaces of the back teeth especially should be brushed and also the inner surfaces. The brushing should be done the last thing at night and in the morning. Of these the cleaning at night is by far the more important, since, as we have seen, the danger of dental caries is greater in the night-time. It has been aptly said that to clean the teeth at night is a hygienic duty, while to clean them in the morning is a social duty.

The toothbrush habit should be started early. When the temporary teeth erupt, they should be cleaned by the mother or nurse; if this is done children will soon get to like the toothbrush. Where there are several children care should be taken not to get the brushes mixed. This is especially apt to occur when the children are of an age to clean their

own teeth, and obviously under such conditions the toothbrush could become a source of danger.

### Tooth Powders and Pastes

It is usual to use with the toothbrush some powder or paste to aid in the cleaning ; they are undoubtedly helpful, although it must be stated that *no* tooth powder or paste is capable of doing all that the blatant advertisements in the papers proclaim.

First of all, the powder or paste should be free of gritty abrasive particles, since these in conjunction with the brush may wear grooves in the teeth, while the insoluble particles may collect under the gum and act as irritants. For these reasons a paste is perhaps preferable to a powder, since it must of necessity be free from gritty particles ; then the powder or paste should be alkaline, so as to help neutralize any acids which may be caused by fermentation.

It should also be detergent or cleansing, and this is best attained by the presence of soap in the dentifrice which should always be regarded as a necessary ingredient.

It should be a little astringent and also antiseptic, although it is quite impossible for any dentifrice to be antiseptic in such a degree as to materially

lessen the germs in the mouth; were it strong enough to do so it would harm the mucous membrane of the mouth.

The following are useful prescriptions:—

*Tooth Powder.*—Take of

| | |
|---|---|
| Heavy Carbonate of Magnesia . | 2 drachms. |
| Hard powdered soap . . | 1 drachm. |
| Potassium Chlorate . . | 1 drachm. |
| Oil of Wintergreen . . . | 8 minims. |
| Otto of Roses . . . | 4 minims. |

Precipitated Chalk to make up 1 ounce.

*The Tooth Paste.*—Take of

| | |
|---|---|
| Prepared Chalk . . . | 3 ounces. |
| Hard powdered soap . . | 1½ ounces. |
| Sodium Benzoate . . . | 1 drachm. |
| Oil of Peppermint . . . | 10 minims. |
| Thymol . . . . . | 4 grains. |
| Saccharine . . . . | 3 grains. |

Glycerine sufficient to make a paste.

### Floss Silk and Toothpicks

If the teeth are crowded, or there are many fillings present, and there is a tendency for food to get jammed between the teeth, then the use of floss silk or a toothpick is useful. The former can be obtained

at most chemists, and is conveniently put up in reels. It is used at night after the teeth have been cleaned ; a length is taken and passed down between each tooth, and then pulled backwards and forwards against the sides of the teeth, thus dislodging any food particles. It is a little difficult to use correctly, but where there is a tendency for food to lodge its value is considerable. A toothpick may also be useful : it is rarely needed in a healthy mouth with evenly disposed teeth ; but where teeth have spaced slightly or the gums have receded, its use becomes necessary.

The best toothpicks are made of quills or hard wood, and they should only be used *once*. Toothpicks of metal are thick and liable to injure the gum.

### Mouth-washes

There is a limited use for mouth-washes in the prevention of dental disease, but they should not be used except when specially ordered by the dental surgeon. Mouth-washes are two kinds : those which are alkaline and are used to counteract the acidity of the mouth, and those which are antiseptic and lessen the growth of germs. In a normal mouth a mouth-wash is unnecessary, but under certain conditions, for instance, where, owing to irregularities, the

teeth are difficult to clean, or where some periodontal disease is present and stagnation liable to occur in the ' pockets,' or where caries is particularly rampant, then a mouth-wash may be useful, but the onus of ordering it should rest on the patient's dental or medical adviser.

Under normal conditions the saliva is the best mouth-wash ; it is always where it is wanted, and acts all the time.

When a mouth-wash is used it should be remembered that its mechanical effect is equally as important as its antiseptic or alkaline effect. To be used properly a mouthful should be taken and vigorously swished backwards and forwards between the teeth ; this effect is *not* obtained by moving the head from side to side but by vigorous movements of the tongue, lips, and cheeks, so that the fluid is forced between the teeth. This may sound absurdly simple, but observation shows that many people do not realize it, and merely pour the fluid from one side of the mouth to the other by moving the head from side to side. All the mechanical effects of the mouth-wash can be got by using plain water, and it is quite useful to take a mouthful of water after cleaning the teeth and use it as directed above.

In addition to these should be mentioned the desirability of regular inspection of the teeth, especially

in children. By now the reader should have realized that the clue to the prevention of dental disease lies in the care of the child. The temporary teeth should be carefully watched, and if despite precaution cavities appear, they should be filled; every effort should be made to retain the temporary teeth for their full period so as to ensure a regular succession of the permanent teeth. There is an idea with many people that the temporary teeth cannot be stopped, or are not worth it; this is quite wrong, they are as important to the child as the permanent teeth to the adult.

The ideal plan would be for dental inspection to start at three years when the temporary teeth are in place; it should be carried out thrice yearly during school life, that is, during the period covering the eruption of the permanent teeth, and afterwards twice yearly.

If this were done in addition to the preventive treatment already described, the amount of remedial work needed by most people would be very small, and the dental chair would cease to be a bogy to the child and a source of income to the comic artist.

## CHAPTER X

### A PUBLIC HEALTH DENTAL SERVICE

THE dental problem is a national one, but at present there is no comprehensive national scheme in prospect to cope with the evil. A tentative beginning has been made, however, but in a partial and typically piece-meal fashion; still it is at least a recognition of the existence of the problem and its menace to the public health.

It is not within the province of this book to outline any scheme, but some of the more important points may be touched upon. Now, the problem of the prevention of dental sepsis is a threefold one.

1. We have the need for a widespread recognition of the fact that dental disease *is* a harmful thing; along with this must go a knowledge of how the teeth are built up and come into place, of the ways in which they are destroyed, and of the means by which they may be kept healthy. To state these facts has been the object of this book.

It is necessary for the knowledge to be widely spread, indeed universal, since it is within the power

of all parents to do a great deal in preventing dental disease in their children.

2. There must be systematic inspection and treatment of all children during school life.

3. Adequate remedial treatment of dental disease in the way of extraction, stoppings, and the provision of artificial teeth should be within the reach of all.

With regard to the first part of the problem, namely, the knowledge of the facts of the disease and its prevention: this could be attained by the wide diffusion of simple leaflets on the subject and by lectures on the care of the teeth.

These latter are a useful way of reaching a large number of people; in every town and village they should be given with lantern slide illustration. Wherever dental treatment goes on, instruction in the prevention of dental disease should also go on side by side with the treatment.

At the Royal Dental Hospital of London lectures on the care of the teeth are given from time to time to the patients; they are well attended and appreciated. This example might well be copied more widely at all dental clinics. Such lectures have also been given in small towns and villages; they have been invariably well attended and appreciated. But there are yet still very many people who are ignorant of the facts: they would gladly learn but

there is often no way of learning. In the future such instruction may become one of the duties of the State, but in the meanwhile we must rely on private effort to dispel that mist of ignorance which is the real source of trouble.

### Inspection and Treatment

The school clinic for the inspection and treatment of school children is an institution of recent growth dating not more than seven years back. At first carried on through the medium of private benevolence, school clinics have been taken up by local authorities and are now numerous. A beginning has been made, but we are still far from the stage when all school children will receive systematic inspection and treatment of their teeth. At present in most clinics the treatment is restricted to children between six years and eight years, the idea being to save where possible the first permanent molars which erupt between these years and are peculiarly liable to caries. To be really effective the treatment should commence earlier when the temporary dentition is complete, at about three years, since it is most important to preserve the temporary teeth in a sound condition until they are shed naturally. Then again the treatment should go beyond the age of eight years, and extend throughout school

life while the other permanent teeth are erupting. The present method is only a compromise ; children come to the clinic with dental disease so far advanced that extraction is the only possible treatment, while in those cases in which the teeth are saved the benefit is often lost by the lack of subsequent treatment. In saying this there is no desire to belittle school clinics but simply to point out that their existence does not solve the problem. There is a tendency for the lay mind to think that the establishment of a few clinics is a solution of the problem of dental disease ; that when the expert agitates for an extension of the system at a considerable expense, he is merely a crank with his own axe to grind.

From a purely business point of view, it would pay the State handsomely to establish a Public Dental Service on a large scale and to endow it liberally ; the resultant efficiency of the individuals forming the nation would be enormously increased.

At present public dental treatment is carried on in a haphazard way so that there are wide gaps in between the stages of treatment, so that any good work performed is often annulled by the neglect which occurs before the next relay of treatment comes along.

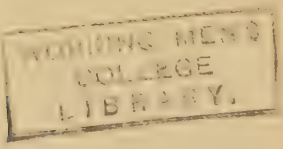
It is necessary therefore to co-ordinate all the different centres of treatment, and to extend their

scope so that all children may receive treatment during the whole period that the teeth are being formed and erupted.

With regard to the public treatment obtainable in later life, we have at present to rely on the dental department of the general and special hospitals and on a few dental hospitals. At the former the work is done by dentists in practice. The exigencies of time and the number of patients practically compel such treatment to be merely the extraction of teeth.

Much good results from this, but the fact that so many patients need extensive extraction is in itself a confession of failure; it shows that preventive treatment is still in its infancy. A certain amount of conservative work and the provision of a limited number of sets of artificial teeth is carried on at the dental hospitals, where there are a number of dental students to do the work. Even so only a small amount of the patients who apply can be dealt with. Especially urgent is the problem of the provision of artificial teeth for patients who are unable to masticate their food through lack of teeth. Anyone engaged at a dental hospital is constantly seeing people who are being slowly poisoned by the presence of septic teeth, and yet they will not have them extracted because they are too poor to pay for artificial teeth.

Recently St. Bartholomew's Hospital has been the recipient of a large sum of money, the interest of which is to be expended in paying part of the cost of artificial teeth. The generous donor will have the satisfaction of knowing that his gift will be immediately productive of untold benefit. Dental disease, because it is not often concerned with the issues of life and death, does not make that dramatic appeal to the public purse that some other diseases do, so that the claim of the dental institutions are often overlooked, and yet there are few objects more worthy of support than the efforts to stem the tide of dental sepsis. It offers to the philanthropist an unique opportunity of rendering unquestionable service to the well-being of the community.



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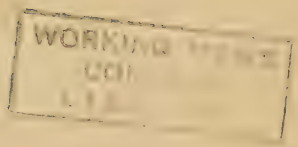

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